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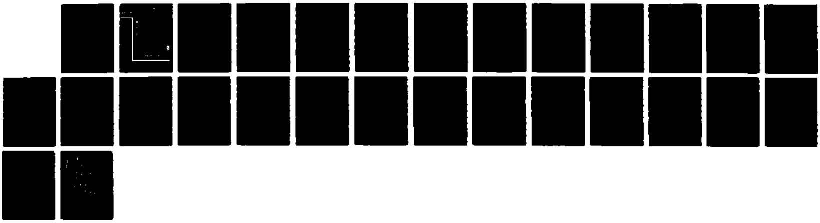

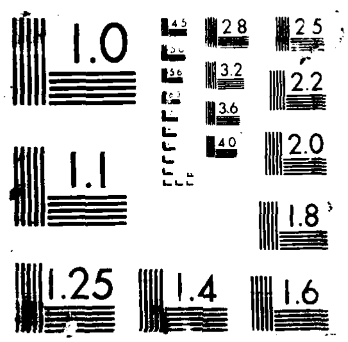
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HUMAN RESOURCES

COMPARATIVE ASPECTS OF MULTIPLE PROCESSES OF ATTENTION

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In this paper, first, there are examples of human and animal research in which attention is separated into various components. Terms used to designate various aspects or subcomponents of attention are compared from different research paradigms. Secondly, four experiments on the time course of human attentional effects on discrimination of different stimuli are discussed in relationship to other research in the literature. For these experiments, a precue was used to move attention to the target location. Accuracy in discrimination of the target as a function of the time between precue and target was measured. In three of these experiments, targets differed as to line arrangement or line orientation. It was suggested that line arrangement discrimination requires focused attention whereas line orientation discrimination may not. The data were related to some of the dichotomous terms used to describe processes that differ in the need for focused attention. In a fourth experiment, eccentricity of the target was varied. These data provided evidence of time invariant attention movement for distances less than ten degrees. The results from the four experiments are discussed (a) as separation of line orientation discrimination from line arrangement discrimination by the need for focused attention and (b) as examples of engagement, movement, and disengagement from stimuli in a discrimination task.

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SUMMARY

For psychologists, attention has long been a fascinating subject. Since early in this century, there have been many diverse opinions on attentional phenomena and how to study them. In retrospect, it is likely that various researchers were studying different processes that each appeared to be "attention." This report provides a brief introduction to the contemporary study of attention. Diverse types of attention are described with examples from the animal literature, from human neurological data, and from human covert visual attention. Distinctions between (a) selective attention, maintenance of attention, and shift of attention, (b) preattentive (global attention) and focused attention, (c) parallel and serial search, (d) constant and variable mapping, and (e) stage 1 and stage 2 of attention are presented. Four of our experiments are discussed in relationship to other research in the literature.

PREFACE

This report represents a portion of the research program accomplished under Project 2313; Task 2313T3, Perceptual and Cognitive Dimensions of Pilot Training, Dr. Elizabeth L. Martin, Task Scientist. The division has an ongoing basic (6.1) research program in visual attention to provide knowledge needed in order to understand attention to the visual scene. This knowledge is of benefit to the AFHRL/OT 6.2 and 6.3 R&D programs, which are dedicated to the development and evaluation of visual systems for use of flight simulators. This paper is based in part on a presentation made at the American Psychological Association Convention in New York City in August 1987. The experiments on visual attention were conducted by Dr. Cheal while on a University Resident Research Program Fellowship at the Operations Training Division, Air Force Human Resources Laboratory, Williams Air Force Base, Arizona.

The author is indebted to Dr. Don Lyon for scientific collaboration on the research, to Dr. David Hubbard for statistical consultation, and to Christopher Voltz for programming expertise.

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I. INTRODUCTION

Attention has been a fascinating subject for study since early days of research. In 1890, William James said "our attention is quite independent of the position and accommodation of the eyes." At the beginning of this century, there were many diverse opinions on the phenomena associated with attention and how to study them. When psychology became more rigorous, little research focused on attention, because experimental psychologists felt that it could not be studied objectively. Only more recently, with behavioral methods pioneered by people like Broadbent (1977), Ericksen (Eriksen & Collins, 1969; Eriksen & Hoffman, 1972), and Posner (1980) has progress been made in quantifying these phenomena. However, even now, researchers who study attention in different paradigms do not always converse. Two possible explanations for the poor interaction among researchers of attention are that (a) they do not use the same vocabulary and (b) they are studying different processes of attention.

To demonstrate the first point, the groups of terms below provide examples of the diverse vocabularies used in different research "worlds." The first group of words was defined objectively for behaviors in the gerbil (Table 1). The gerbil demonstrates "awareness" of an object by licking, sniffing, and biting it. He shows "selective attention" to an object when it is novel and not when he becomes familiar with it. Gerbils are capable of "maintaining attention" for periods dependent on the affect of the stimulus. Gerbils will also "shift attention" to another stimulus if it is novel or of potential relevance.

Table 1. Terms of attention

AWARENESS
SELECTIVE ATTENTION
MAINTENANCE OF ATTENTION
SHIFT OF ATTENTION

In the gerbil research, I was able to separate these types of attention psychopharmacologically (Cheal, 1978, 1980, 1981, 1983, 1984), surgically (Cheal & Domesick, 1979; Cheal, Johnson, Ellingboe, & Skupny, 1984), and developmentally (Cheal, 1987). For instance, some drugs that alter dopamine brain mechanisms (such as apomorphine) affected selective attention, whereas other dopamine agonists (such as piribedil) disrupted shift of attention. On the other hand, an acetylcholine blocker disrupted the ability to maintain attention. Thus, the different types of attention were disrupted differentially by drug treatment. Surgical manipulations also interfered with one type of attention and not others. For instance, castration disrupted the ability to shift attention normally but did not affect maintenance of attention or selective attention. Furthermore, the different types of attention appeared at different times in development. These data support the multiplicity of attentional processes.

Attention also has been separated into subcomponents in clinical research. Mirsky (1986) defined the terms in Table 2 for aspects of attention as he observed them in animal and human studies. In this work, Mirsky and his colleagues provided some evidence for mediation of different parts of attention in distinct brain areas. He based his conclusions on work with primates and with human psychiatric patients.

Table 2. Clinical terms of attention

FOCUS
EXECUTE
SUSTAIN
ENCODE
SHIFT

Mirsky used different terms than I used for the gerbil work, but there may be a correspondence between some of them (e.g., "sustain" vs. "maintain"). I think it is premature with the present state of our knowledge to try to make too close a correlation between the terms used in different research paradigms, although clearly this should be done as additional information becomes available.

In the field of visual attention, Posner (1987) has suggested other terminology to separate various processes of attention (Table 3). These terms will be discussed in detail in the discussion of Section III. They have been derived from research on normal people and brain-injured patients. Posner first showed what appeared to be different parts of attention in normal observers. More recently, he has found that some parts of attention may be disturbed in brain-injured patients while other parts are not.

Table 3. Terms of visual attention

DISENGAGE
MOVE
ENGAGE

Further evidence of different processes of attention has come from comparisons of attention as it affects perception in different sensory systems. During collection of human evoked potentials, different brain areas are active, dependent on the mode of sensory stimuli. This difference is apparent not only in the primary and secondary sensory areas (which are different, of course, for auditory, visual, or somatosensory information), but also in the more anterior neural areas (Woods, in press).

Thus, there are numerous research paradigms each with its own set of terms. This is undoubtedly confusing and warrants further efforts to compare the processes. In spite of the confusion in terminology, the different terms offer strong support for the hypothesis that attention is not a single process but rather, involves a composite of different processes. Inasmuch as attention has been found to differ in component parts in several different systems, it is likely that attention is composed of even more processes or subprocesses than is now known.

II. HUMAN VISUAL ATTENTION

The balance of this report will be used to discuss particular issues in visual attention with examples of research from our work. Researchers have been aware for some time that stimuli are perceived differently dependent upon particular aspects of the stimuli. Table 4 contains a number of different terms that have been used to denote these separate processes for the perception of different types of visual stimuli. The first term of each pair refers to a rapid process that allows parallel search and is unlimited in capacity. The second term refers to a slower process in which search is serial and limited in capacity (longer reaction time with more distractors).

Table 4. Additional terms of visual attention

SEARCH:	PARALLEL		SERIAL
CAPACITY:	UNLIMITED		LIMITED
	PREATTENTIVE	VS	FOCUSED ATTENTION
	DISTRIBUTED	VS	CONCENTRATED ATTENTION
	GLOBAL	VS	FOCUSED ATTENTION
	GLOBAL	VS	LOCAL PROCESSING
	GLOBAL	VS	DETAILED DETECTION
	STAGE 1	VS	STAGE 2 PROCESSING
	AUTOMATIC	VS	CONTROLLED PROCESSING
	CONSTANT	VS	VARIABLE MAPPING

One way that stimuli have been differentiated into these two categories is based on the fact that some stimuli are readily seen (they "pop out" of the visual field) whereas other stimuli must be studied more carefully to find one disparate character. For instance, in Figure 1, the slant that is tilted left is clearly distinguished from the slants that are tilted right, whereas it takes somewhat longer to find the F among the Es even though it is composed of fewer line segments, fewer conjunctions, and fewer terminators, and has less overall luminance.

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  /   /   /   /   /   /   /
/   /   /   \   /   /   /   /
  /   /   /   /   /   /   /
/   /   /   /   /   /   /   /


E   E   E   E   E   E   E   E
  E   E   E   E   E   E   E
E   E   E   F   E   E   E   E
  E   E   E   E   E   E   E
E   E   E   E   E   E   E   E
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<u>Figure 1</u>. "Popout" stimuli. Comparison of a stimulus that "pops out" (above) with a stimulus that does not (below).

Texture gradient experiments also provide examples of stimuli that seem to fit the first term of each set in Table 4. Experiments to determine what characteristics result in the perception of boundaries between areas of different textures have indicated that discrimination is based on a few local conspicuous features (Julesz, 1981). This phenomenon has been demonstrated by differences in line orientation (Beck & Ambler, 1972; Callaghan, Lasaga, & Garner, 1986; Olson & Attneave, 1970), number of terminators (Julesz, 1981), line curvature (Olson & Attneave, 1970; Treisman, 1986), and color (Callaghan et al., 1986; Treisman, 1986). These discriminations have been considered to require only global attention or preattentive processes, because they are made rapidly and are not affected by the number of elements in the field.

A third method used to study the difference between stimuli that appear to be noticed automatically and those that take more careful study is the search technique. In this paradigm, observers must search for a target character and respond as quickly as possible. Reaction time is the typical measure used. Stimuli that pop out are generally found quickly in a search test, and independently of the number of noise items that are in the display. These items tend to differ by a single feature such as line orientation. For characters that do not pop out quickly, observers have longer reaction times with more distractors.

Some effort has been made to test the hypothesis that stimuli that pop out do not require focal attention. Beck and Ambler (1972) presented a single letter (an L or a tilted T) in a display of upright Ts. They found that a tilted T was discriminated better than was an upright L under these conditions. However, in a field that was limited to eight characters, with a precue to correctly indicate the target location, there was no significant difference in accuracy of detection of an L or a tilted T (Beck & Ambler, 1973). Only when two or more locations were cued, so that attention was distributed over the target and noise items, was there a decrement in detection performance for the L but not the tilted T.

In other experiments, features that allowed rapid texture decisions (such as one L among Xs) were the same features that were detectable by a rapid parallel process when tested with briefly presented stimuli (Bergen & Julesz, 1983). For these stimuli, there was no decrement in accuracy with more noise characters, and there was no improvement in accuracy if the interval between stimulus presentation and presentation of a mask was increased beyond 160 msec. In contrast, an L among Ts required 300 msec to reach asymptote.

Discrimination of a tilted T from an upright T, or an L from an X, is most likely made on the basis of line orientation, whereas discrimination of an L versus an upright T is most likely made on the basis of the arrangement of line segments. Discrimination of line orientation could be thought of as an automatic response that is made without the need for focal attention. If it is automatic, then line orientation discrimination would be involuntary, would operate in parallel over the visual field, and would be independent of other tasks. In contrast, discrimination of line arrangement could be thought of as a controlled response in which focused attention is necessary (Kahneman & Treisman, 1984).

III. LOCATION CUING RESEARCH

In all of these experiments, it is assumed that the difference in the responses between the two types of stimuli is the difference in the need for attention. However, in most of this research, the locus of attention has not been explicitly manipulated in order to see what effect attention has on discrimination of stimuli assumed to be processed preattentively in comparison to discrimination of stimuli that require focused attention.

A. Experiment 1

In research performed in collaboration with Don Lyon, attention has been directly manipulated in order to determine the difference in the time course of attention effects on discrimination of line orientation (stimuli that are thought to be processed without focused attention) versus discrimination of line arrangement (stimuli that are assumed to require focused attention). Using the method introduced by Lyon (1987), it was possible to assess the improvement in discrimination performance (proportion correct) as a function of the time allotted to shift attention to the target. This method contains elements of techniques used by Eriksen and Hoffman (1972), Posner (1980), and Bashinski and Bacharach (1980). The key difference between the present research and the texture segregation and visual search studies discussed earlier is that here attention is manipulated directly by presenting a spatial cue in the area of the target a few milliseconds before the target is presented.

To determine the time course of attention effects, the interval between the onset of a valid target location cue and the onset of the target itself (cue-target stimulus onset asynchrony, SOA) is varied. If orientation discrimination benefits less from attention than does line arrangement discrimination, then it would be predicted that there would be a smaller effect of SOA on discrimination of slanted lines than on discrimination of sideways Ts. This prediction was supported by our data.

In our experiments (Cheal, Lyon, & Hubbard, 1987), observers were directed to maintain fixation on a central point (eye movement was monitored), and attention was directed to a relevant peripheral target by a rectangular cue presented in the appropriate location. Target duration was carefully controlled by presenting a mask to prevent further processing of the visual information. Three target durations were used. Discrimination of targets composed of two conjoining line segments (sideways Ts; presented for 50 msec, 67 msec, and 84 msec) replicated the results found earlier (Lyon, 1987). As shown in Figure 2, time to shift and focus attention was required for this discrimination, and benefits increased with longer cue-target SOAs that allowed attention to accumulate at the target.

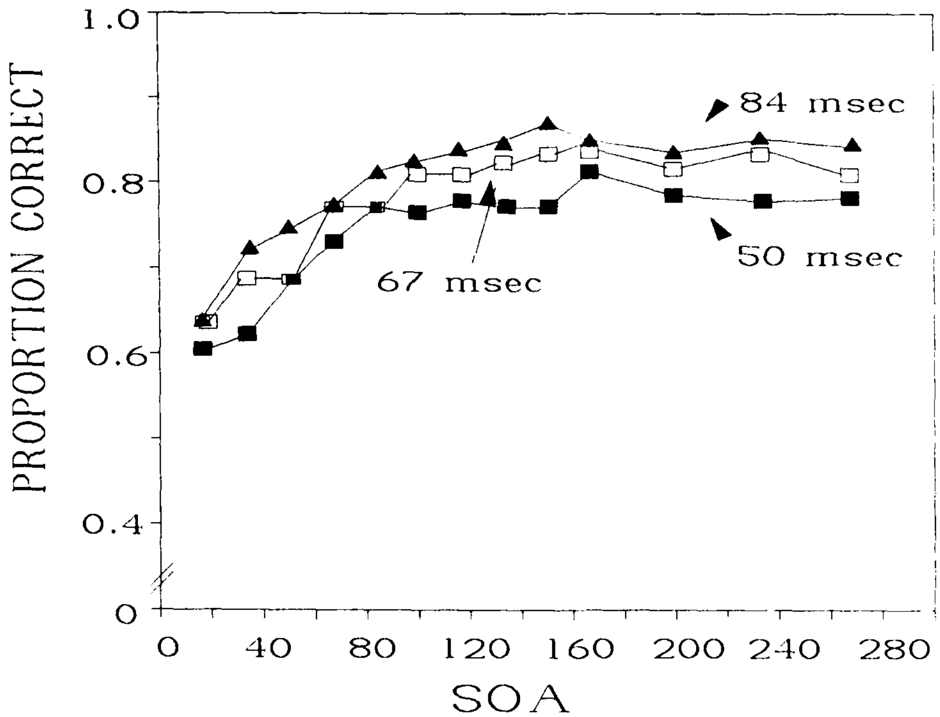
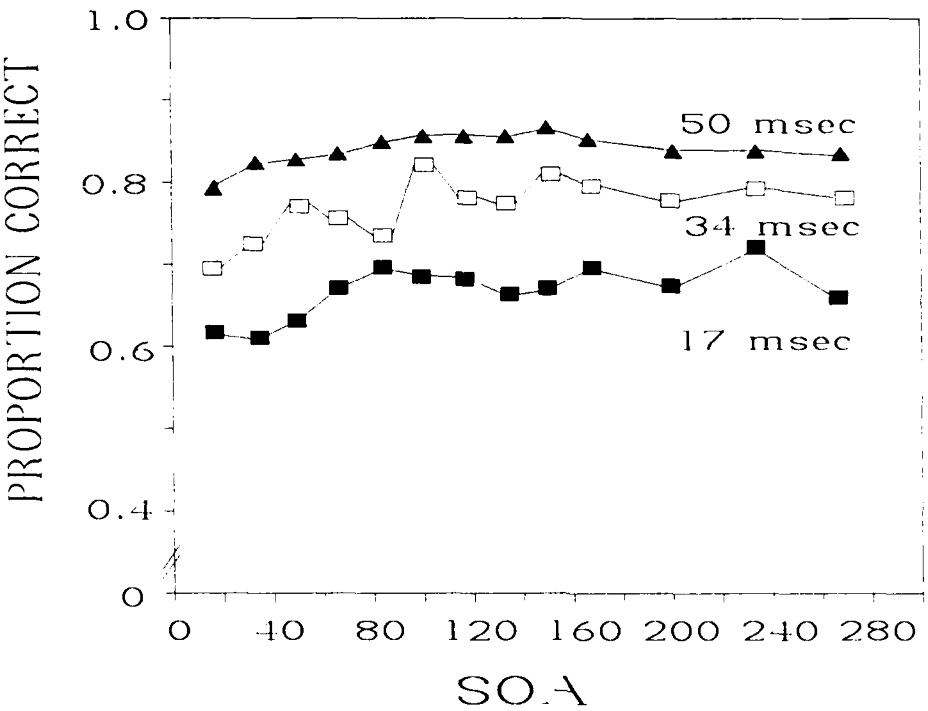


Figure 2. Proportion correct as a function of cue-target SOA for targets that differ in line arrangement (sideways Ts). Standard deviation of the proportion was less than the size of the symbols. Target durations: 84 msec: triangles; 50 msec: filled squares; 67 msec: open squares. Data from Cheal et al., 1987.

In contrast, as shown in Figure 3, discrimination of targets that differed in orientation of lines (slanted obliquely either right or left of vertical) was minimally facilitated as the SOA was increased from 17 msec to 268 msec. Thus, a clear difference in the need for attention for discrimination of the two types of stimuli was demonstrated.



<u>Figure</u> <u>3</u>. Proportion correct as a function of cue-target SOA for targets that differ in line orientation (Slants). Standard deviation of the proportion was less than the size of the symbols. Target durations: 17 msec: filled squares; 34 msec: open squares; 50 msec: triangles. Data from Cheal et al., 1987.

B. <u>Experiment 2</u>

The same results were replicated in a second experiment (also conducted in collaboration with Lyon) in which two sets of stimuli were created using the same number of line segments, the same number of conjunctions, the same number of terminators, and the same number of pixels for each. The only difference between the two sets of stimuli used was that one set of stimuli (sideways Ts) differed from each other only in the arrangement of line segments, whereas the other set of stimuli (Ys) also differed in the orientation of the shorter line.

The data for discrimination of sideways Ts replicated the data in Experiment 1 (Figure 4). Of particular interest, the data for discrimination of Ys were very similar to the data of Slants (Figure 5).

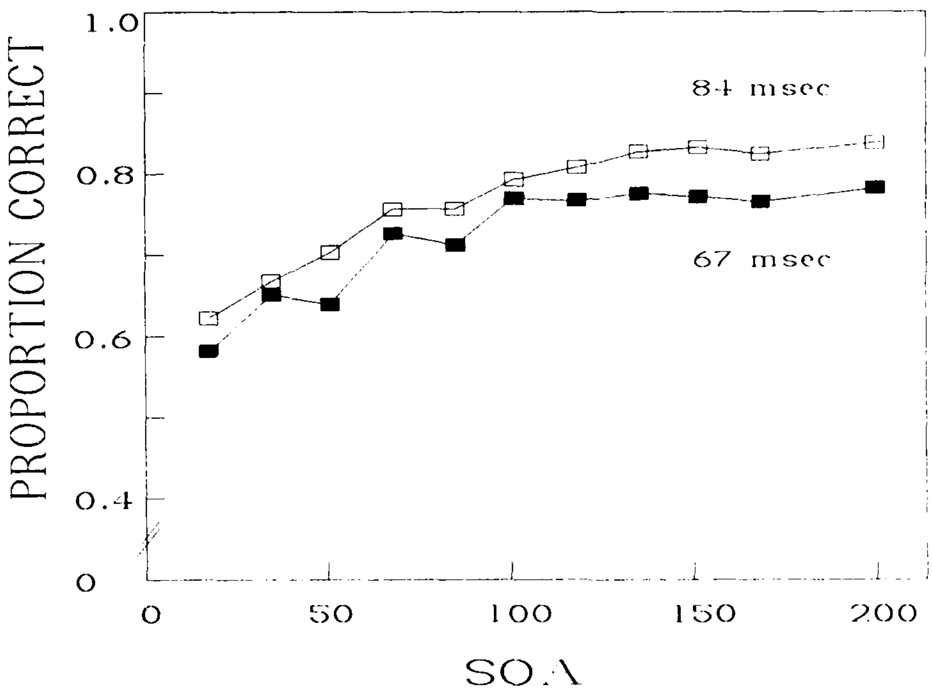


Figure 4. Proportion correct as a function of cue-target SOA for targets that differ in line arrangement (sideways Ts). Target durations: 67 msec: filled squares; 84 msec: open squares.

The differences between responses to the two types of stimuli were very strong. Not only were the results highly significant, but they were shown in each of the observers, they were not due to differences in overall proportion correct, and they occurred for each duration of stimulus presentation. They were found when the stimuli were composed of equal numbers of line segments, junctions, and line terminators. Masking of the target by the peripheral cue should not have had a large influence on these results, inasmuch as Lyon (1987) showed that observers given sufficient practice had very similar responses when the target was cued with a central arrow rather than a square in the target area.

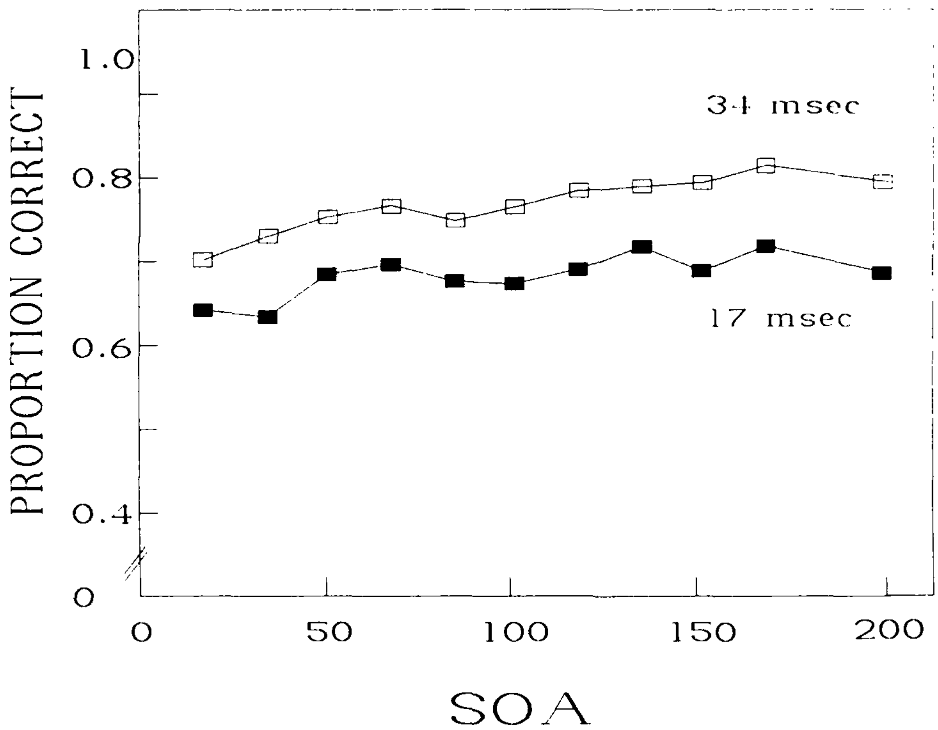


Figure 5. Proportion correct as a function of cue-target SOA for targets that differ in line orientation (Ys). Target durations: 17 msec: filled squares; 34 msec: open squares.

The large differences between discrimination of line orientation and discrimination of line arrangement are demonstrated in Figure 6. For each duration for each observer, a difference measure was computed by subtracting the proportion correct at 17 msec SOA from the mean proportion correct for all SOAs above 100 msec (the asymptote score). There was no overlap of the difference measures between Slants and sideways Ts or between Ys and sideways Ts. Note that difference measures did not separate for different target durations.

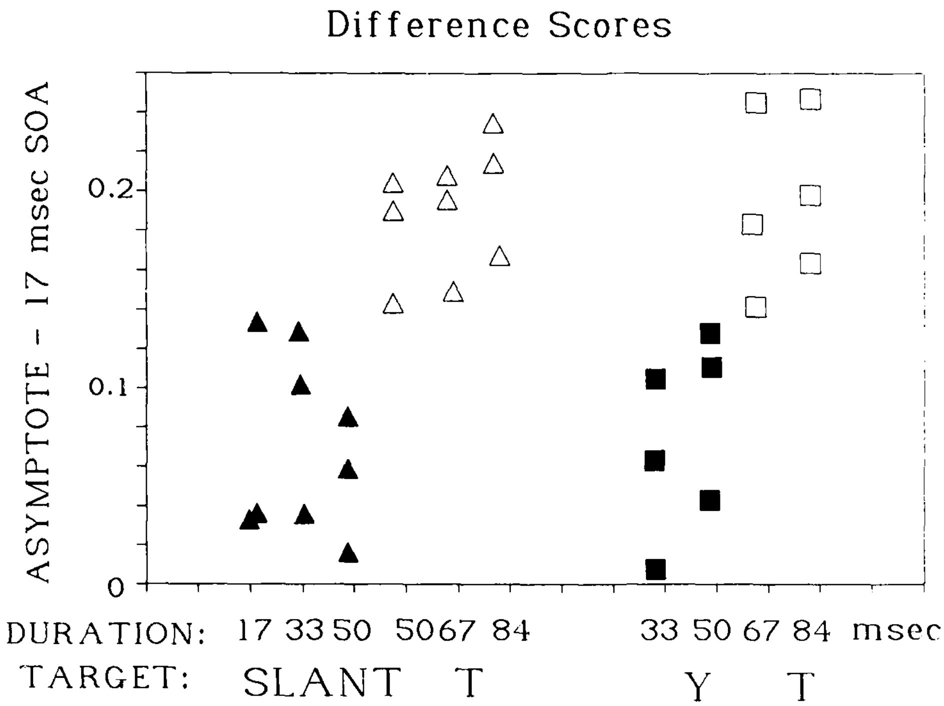


Figure 6. Difference scores that show the improvement with SOA for SLANTS (filled triangles) and Ts (open triangles) in Experiment 1 and for Ys (filled squares) and Ts (open squares) in Experiment 2. Difference was computed between proportion correct for 17 msec SOA and proportion correct for asymptote for each target duration for each observer for each target type.

The differences in the effects of attention on the two types of stimuli were shown even though a number of factors previously found to be associated with differentiation of focused versus global responses were not present. These factors include (a) semantic content (Broadbent, 1977; Burke, White, & Diaz, 1987); neither stimulus needed semantic interpretation; (b) detection versus discrimination (Sagi & Julesz, 1985a); discrimination was required for both sets of stimuli; and (c) amount of practice or experience in the task (LaBerge, 1981). Automatic detection of search targets can develop with practice; however, in these experiments, discrimination of Ts was greatly facilitated by attention even after considerable practice. Improvement with practice occurred with both types of stimuli, yet the difference between the size of the attention effects on Slants and Ts in Experiment 1 did not decrease in 24,000 trials under consistent mapping conditions (Schneider & Shiffrin, 1977). There were no significant differences in the interactions between target type and cue-target SOA for early, middle, and late trials. Moreover, the same observers still showed this difference between responses to Slants and to Ts in 10,000 subsequent trials in another experiment (third experiment, described below).

C. Experiment 3

In a third experiment in our laboratory (Cheal et al., 1987), we tested whether orientation discrimination would be affected by focusing attention elsewhere in the visual field. If, as the results of the first two experiments suggest, the process of orientation discrimination is relatively unaffected by focal attention to the target area, then it might also be unaffected by the focusing of attention elsewhere in the visual field (Kahneman & Treisman, 1984). On the other hand, decrements in reaction time are found even in detection of simple stimuli when the target location is incorrectly cued (Posner, 1980). Such data predict that decrements in performance in orientation discrimination will occur if attention is first directed to a nontarget location.

These alternative predictions were tested in the third experiment by reducing the probability that the spatial cue would direct attention to the correct target area. A cue misdirected attention to the wrong location on 20% of the trials. A decrement occurred on incorrectly cued trials (invalid) in comparison to correctly cued trials (valid) for both types of stimuli. The differences between valid and invalid trials for stimuli that differed in line arrangement (sideways Ts) are shown in Figure 7. The differences as a result of validity for stimuli that differ only in line orientation (Slants) are shown in Figure 8.

Differences in the effect of attention on discrimination of the two types of stimuli may occur because only discrimination of Ts requires focus of attention on the target. On the other hand, both types of targets may be affected by the need to shift attention from an incorrectly cued location.

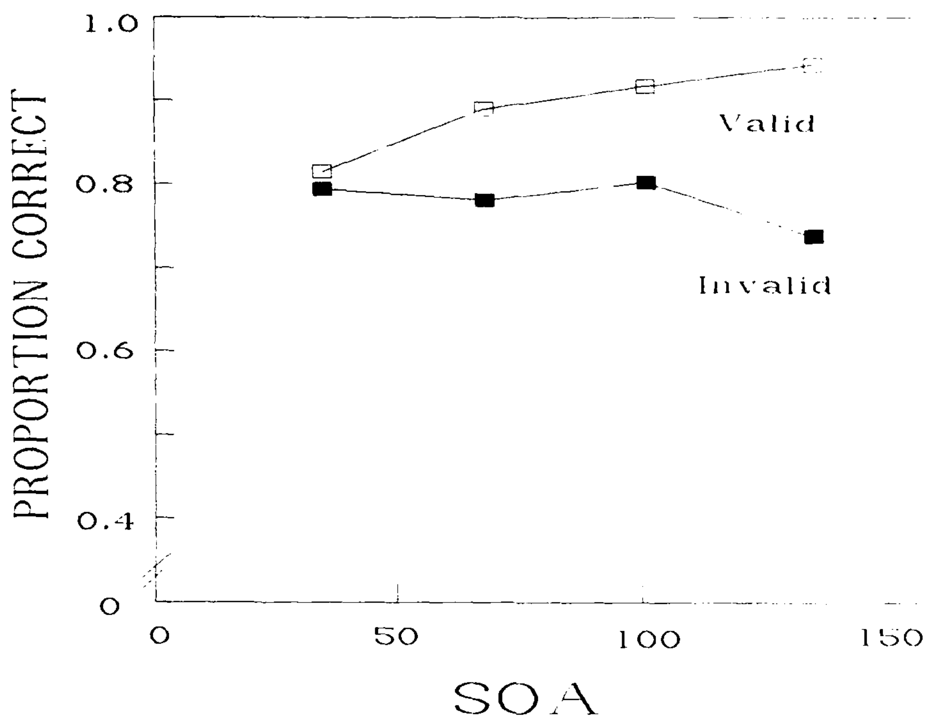


Figure 7. Effects of valid and invalid cues on discrimination of sideways Ts. Proportion correct as a function of cue-target SOA for targets that differ in line arrangement (sideways Ts) in Experiment 3. Mean of two durations for valid (open squares) and invalid (filled squares) trials. Data from Cheal et al., 1987.

D. Discussion

If the inference from the earlier studies is correct and stimuli that differ in the orientation of their component lines are discriminated in the absence of focal attention, then these stimuli would not benefit from a spatial cue. This possibility was tested in the first two experiments. It was shown that discrimination of line orientation neither needed as much focal attention nor benefited from it nearly as much as did discrimination of line arrangement. This was true even when discrimination of the two stimuli was approximately equated for overall difficulty. However, when the cue directed attention away from the target area, there was a decrement in accuracy for both orientation discrimination and discrimination of line arrangement.

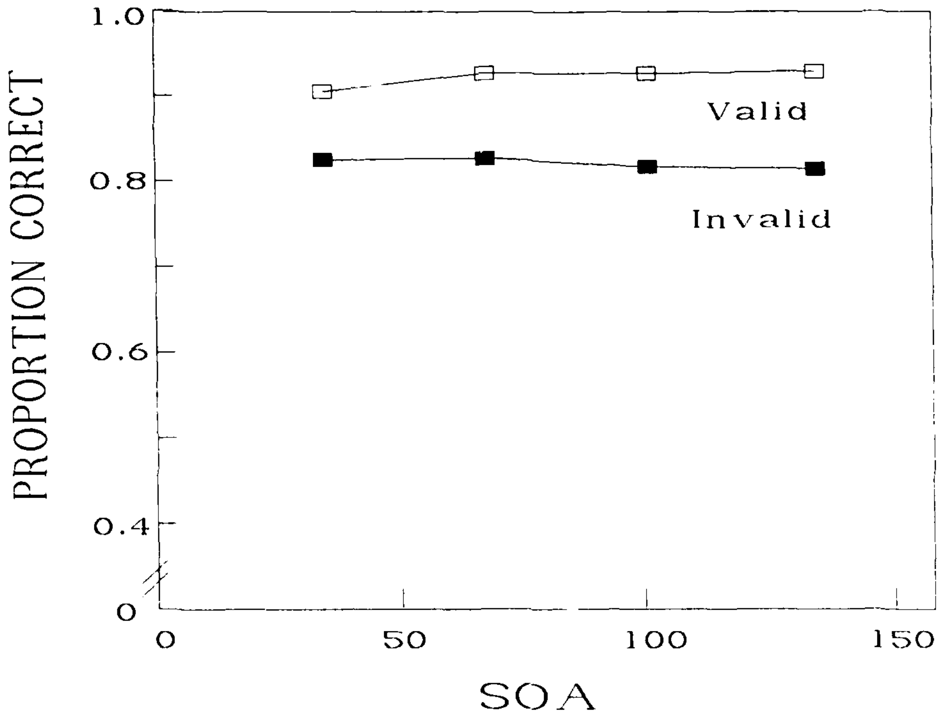


Figure 8. Effects of valid and invalid cues on discrimination of Slants. Proportion correct as a function of cue-target SOA for targets that differ in line orientation (Slants) in Experiment 3. Mean of two durations for valid (open squares) and invalid (filled squares) trials. Data from Cheal et al., 1987.

The large difference in the size of attention effects in *Slant or Y conditions in comparison to T conditions is a robust* result that could be explained by a number of theoretical possibilities. The most attractive hypothesis is one that has been proposed in several models of visual information processing that differentiate between global, preattentive, parallel processes and focused, concentrated, serial processes (Neisser, 1968; Schneider & Shiffrin, 1977; Shiffrin & Schneider, 1977; Treisman & Gelade, 1980). That is, discrimination of Slants or Ys, based on line orientation differences, may be a global, preattentive process that occurs automatically, whereas discrimination of Ts, based on conjunction of line segments, is a controlled process that requires time to focus attention (Kahneman & Treisman, 1984). This interpretation of the first two experiments is most consistent with a large segment of the literature.

Data from the third experiment, however, may not be consistent with the idea that orientation discrimination is a completely automatic process (Kahneman & Treisman, 1984), because there was a decrement in accuracy when either Slants or sideways Ts were incorrectly cued. The strong effect of invalid trials was not merely a function of observers who were "overtrained" on the valid task, because observers who were initially started with 20% invalid trials showed the same effect.

Although the results of the third experiment may seem paradoxical, there is other evidence that also casts doubt on the hypothesis that "automatic targets" do not require focused attention. For example, Hoffman, Nelson, and Houck (1983) interpreted their data to indicate that detection of automatic targets was dependent on allocation of spatial attention. In their experiments, observers were given dual tasks: a search task for a digit among letters and detection of a flicker in one of four lights. Accuracy in reporting the location of the flicker decreased with increasing attention devoted to the search task. In addition, accuracy was higher if the search target was in the same area of the visual field as the flicker.

Another consideration is that attention not only needs to shift to the target, but also may involve other processes. For example, LaBerge (1973) suggested that attention must be not only switched to a target, but it must also be switched away from a previous target. More recently, as discussed in the Introduction, Posner (1987) has proposed that orienting attention to a visual stimulus without eye movements can be considered in terms of three mental operations: (a) disengagement of attention from the current focus of attention; (b) movement of attention to a new stimulus; and (c) engagement of attention on that stimulus (Posner, Walker, Friedrich, & Rafal, 1984).

Disengagement has been shown to vary with the task attended (LaBerge, 1983).

Movement has been described as an analogue function because it was thought that it moved at a fixed velocity (Shulman, Remington, & McLean, 1979; Tsal, 1983). However, recent data collected in our laboratory in collaboration with Don Lyon showed that there was no difference in proportion correct at short SOAs for stimuli at 2^{o}, 6^{o}, or 10^{o} (Figure 9). There were large differences in the asymptote of performance, however. Because this difference could be due to differences in acuity at different eccentricities, we are repeating this experiment with stimuli that are sized according to acuity at each eccentricity. Preliminary data show very similar proportion correct/SOA curves for the three eccentricities. Thus, they support time invariant movement of attention in the near periphery.

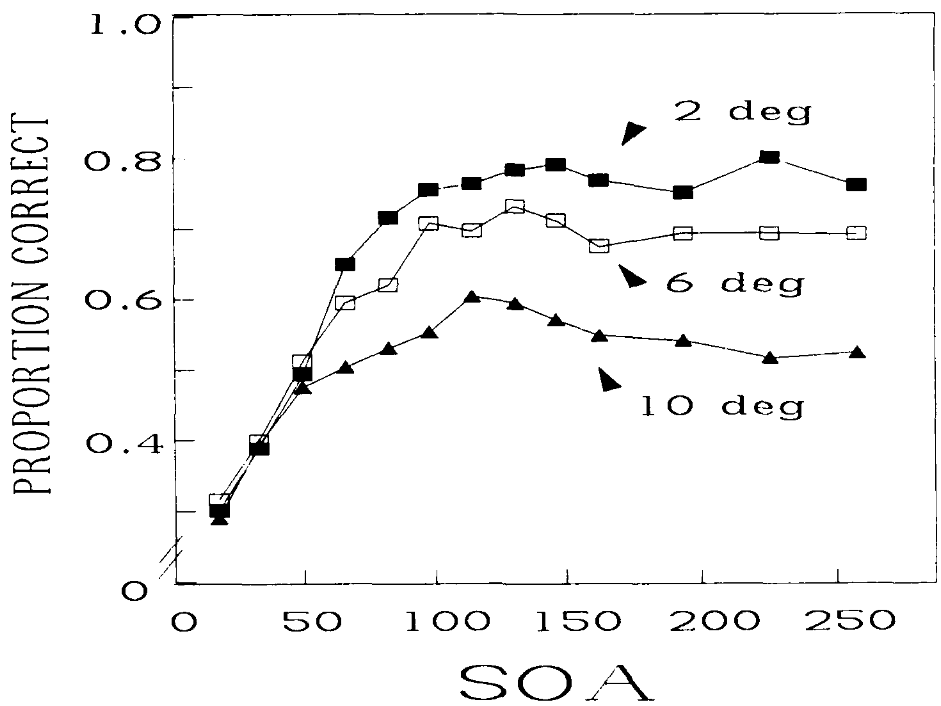


Figure 9. Proportion correct as a function of SOA for stimuli that appeared at 2° (filled squares), 6° (open squares), or 10° (triangles) from fixation. Trials were conducted in the same manner as those in Experiments 1 and 2. All conditions were mixed randomly within blocks.

Engagement can be considered to require a different optimum amount of time for attentional effects, dependent on the stimulus. Thus, a large increase in accuracy as a function of SOA is seen for targets differing in line arrangement, but not for those differing in line orientation.

The decrement in performance on invalid trials in the third experiment described above may be consistent with the concept that attention must be disengaged from the current focus of attention before it can be shifted to a new target. Perhaps attention has to be disengaged from the incorrect location before observers can make any discrimination, even one that does not require focal attention on the target. A similar argument could explain the small facilitation of attention in discrimination of Slants or Ys in the first two experiments. Disengagement from the fixation point may be required in these cases. Further application of the Posner et al. (1984) framework suggests that the large increment in accuracy that occurs with longer cue-target SOAs in discrimination of Ts but not in discrimination of Slants may be due to the amount of engagement of attention; i.e., the accumulation of resources at the target.

Of course, there could be additional explanations of these data. We are presently conducting further studies to control for some possibilities, such as warning effects or masking.

IV. CONCLUSION

The preferable interpretation of results of these experiments (in our opinion) indicates that the first five sets of terms in Table 4 could be used to designate the processes involved in discrimination of line orientation versus discrimination of line arrangement. That is, processes needed for discrimination of line orientation may be said to be "preattentive," "distributed," or "global," whereas attention needed for discrimination of line arrangement may be "focused," "concentrated," or require "local" or "detailed" processing. Our data may also represent Stage 1 and Stage 2 processing, respectively. It is possible that discrimination of line orientation requires only Stage 1, and that discrimination of line arrangement also requires Stage 2. On the other hand, they may be two completely separate processes.

In further reference to Table 4, discrimination of line orientation and discrimination of line arrangement do not separate completely as to automatic versus controlled processing. Although there was evidence for automaticity in the first two experiments, the data from the third experiment do not fit neatly into that classification.

Further, our data do not separate the two mapping conditions inasmuch as both sets of stimuli had constant mapping; i.e., the same stimulus types appeared in each trial of a block. Conversely, both sets of stimuli were presented in trials in which the target could vary in location on each trial. In any case, the conditions for the two types of stimuli were identical.

In closing, these data furnish further evidence that attention is a composite of processes. A major task in the field of attention research will be to bring some order into the various attentional processes and the vocabulary that is used to designate them.

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